

5 **THE EMBODIMENTS OF THE INVENTION IN WHICH AN
EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE
DEFINED AS FOLLOWS:**

1. An ultrasonically enhanced medical device comprising:
 - a. a fluid container having a discharge end,
 - b. a fluid discharge means disposed in connection with the fluid container
10 so as to define a fluid retaining reservoir, the discharge means for applying a
selected pressure to a fluid in the fluid retaining reservoir for ejecting said fluid
from the reservoir through the discharge end,
 - c. a first conduit having an entrance end and an exit end and defining a
first passage therebetween, the entrance end disposed at the discharge end of
15 the fluid container, the first passage in communication with the reservoir;
 - d. a needle having a connector end and a distal tip and defining a needle
passage therebetween, the connector end disposed at the exit end of the first
conduit, the needle passage in communication with the first passage;
 - e. a fluid supply means operatively connected to the fluid discharge means
20 for selectively applying the selected pressure to the fluid,
wherein the selected pressure ejects the fluid through the discharge end of the
fluid container and travels a first flow path through the first passage and
through the needle passage, for ejection at the distal tip at a fluid flow rate
selected for detection by ultrasound.
- 25 2. The ultrasonically enhanced device of claim 1, wherein the fluid
includes an echogenic fluid.
3. The ultrasonically enhanced device of claim 2, wherein the echogenic
30 fluid is a saline solution.

- 29 -

4. The ultrasonically enhanced device of claim 2, wherein the fluid includes a therapeutic agent.
5. The ultrasonically enhanced device of claim 1, wherein the fluid supply means comprises a drive means operatively connected to the fluid discharge means and an actuator for the selective operation of the drive means.
6. The ultrasonically enhanced device of claim 5, wherein the actuator is manually operable.
7. The ultrasonically enhanced device of claim 5, further comprising a controller electrically connected to the drive means and to the actuator for selectively applying the selected pressure and thereby control the fluid flow rate.
8. The ultrasonically enhanced device of claim 5, further comprising a transducer means for sensing the selected pressure applied to the fluid and for outputting an electrical signal reflective of the pressure for input to the controller.
9. The ultrasonically enhanced device of claim 1, wherein the fluid supply means includes means for adjusting the fluid volume of the fluid ejected at the distal tip.
10. The ultrasonically enhanced device of claim 1, wherein the fluid flow rate is adjustable in real-time.
11. The ultrasonically enhanced device of any one of claims 1 to 10, wherein the selected pressure is pulsed, continuous or intermittent so that the

- 30 -

fluid is ejected at the distal tip in a pulsed, continuous or intermittent fluid flow.

12. The ultrasonically enhanced device of any one of claims 1 to 12,
5 wherein the fluid container is a syringe and the fluid discharge means is a plunger slidably disposed within the syringe.

13. The ultrasonically enhanced device of claim 1, further comprising a
10 valve member disposed at a selected position on the first conduit, said valve member having sealing means for selectively reducing or stopping throughput of the fluid into or within the first passage.

14. The ultrasonically enhanced device of claim 13, wherein the valve
15 member is disposed at the entrance end of the first conduit.

15. The ultrasonically enhanced device of claim 13, wherein the valve
20 member is a one-way valve member for permitting fluid flow into the first passage and to prevent fluid flow in the reverse direction into the discharge end of the fluid container.

16. The ultrasonically enhanced device of claim 1, further comprising an
25 adaptor for releaseable coupling of the connector end of the needle to the exit end of the first conduit, the adaptor defining an adaptor passage for maintaining communication between the needle passage with the first passage.

17. The ultrasonically enhanced device of claim 16, wherein said adaptor
30 includes means for releasably coupling at least one of a second needle having a connector end and a distal tip and defining a second needle passage therebetween.

- 31 -

18. The ultrasonically enhanced device of claim 16, wherein said adaptor includes means for releasably coupling a probe to the needle within the needle passage, the adaptor passage and the needle passage sized to permit the insertion of the probe therein, said probe extending beyond said distal tip.

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19. The ultrasonically enhanced device of claim 18, wherein said probe comprises therapeutic means.

20. The ultrasonically enhanced device of claim 19, wherein the therapeutic means includes means for applying at least one of radio frequency, microwave heating, cyrosurgical freezing, or brachytherapy.

21. An ultrasonically enhanced device of claim 1, further comprising:

- a. a port connector;
- 15 b. a second conduit having a second entrance end and a second exit end and defining a second passage therebetween, the second exit end disposed at the port connector;
- c. a second connector disposed at the second entrance end for connection for the second entrance to a selected medical component,
- 20 wherein the port connector is disposed at a selected portion of the first conduit or at the valve member for permitting communication between the second passage and the first passage.

22. An ultrasonically enhanced device of claim 21 wherein the selected medical component includes:

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- a. a second fluid container having a second discharge end,
- b. a second fluid discharge means disposed in connection with the second fluid container so as to define a second fluid retaining reservoir, the second discharge means for applying a second selected pressure to a second fluid in

- 32 -

the second fluid retaining reservoir for ejecting said second fluid from the second reservoir through the second discharge end,

5 c. a second fluid supply means operatively connected to the second fluid discharge means for selectively applying the second selected pressure to the fluid,

wherein the second selected pressure ejects the second fluid through the second discharge end of the second fluid container and travels a second flow path through the second passage, through to one of the valve member or to the selected portion of the first passage, and through the needle passage, for
10 ejection at the distal tip at a second flow rate.

23. The ultrasonically enhanced device of claim 22, wherein the second fluid supply means comprises a second drive means operatively connected to the second fluid discharge means and a second actuator for the selective
15 operation of the second drive means.

24. The ultrasonically enhanced device of claim 23, wherein the second actuator is manually operable.
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25. The ultrasonically enhanced device of claim 23, wherein the controller is electrically connected to the second drive means for selectively applying the second selected pressure and thereby control the second flow rate.

25 26. The ultrasonically enhanced device of claim 25, further comprising a second transducer means for sensing the selected pressure applied to the second fluid and for outputting an electrical signal reflective of the pressure for input to the controller.

- 33 -

27. The ultrasonically enhanced device of claim 22, wherein the second fluid supply means includes means for adjusting the second fluid volume of the second fluid ejected at the distal tip.
- 5 28. The ultrasonically enhanced device of claim 22, wherein the second fluid flow rate is adjustable in real-time.
29. The ultrasonically enhanced device of any one of claims 22 to 28 wherein the second selected pressure is pulsed, continuous or intermittent so
10 that the second fluid is ejected at the distal tip in a pulsed, continuous or intermittent fluid flow.
30. The ultrasonically enhanced device of any one of claims 22 to 29, wherein the second fluid container is a second syringe and the second fluid
15 discharge means is a second plunger slidably disposed within the second syringe.
31. The ultrasonically enhanced device of claim 22, further including a switch member for switching actuation of the first fluid supply means and the
20 second fluid supply means.
32. The ultrasonically enhanced device of claim 22, wherein the second fluid is a therapeutic agent.
- 25 33. The ultrasonically enhanced device of claim 32, wherein the therapeutic agent includes one or more of:
- a. a liquid drug,
 - b. a solid drug suspended in a fluid,
 - c. a drug eluting microsphere, or other acoustically activated drug delivery
30 system, suspended in a fluid,

- 34 -

- d. a radioisotope labeled drug,
- e. a radioisotope labeled particle,
- f. an imaging system contrast agent for imaging systems including CT scans, MRI, ultrasound or X-ray.

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34. The ultrasonically enhanced device of claim 21, wherein the selected medical component includes a vacuum source for use in tissue aspiration for performing a biopsy.

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35. The ultrasonically enhanced device of claim 21, wherein the selected medical component includes a vacuum source for use in fluid or material drainage.

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36. An ultrasonically enhanced device of claim 21, wherein the medical component includes a catheter for supplying fluids.

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37. An ultrasonically enhanced device of claim 21, comprising a plurality of components (a) to (c), for communication between the first passage and a plurality of passages connected to a plurality of selected medical components.

38. An ultrasonically enhanced device of any one of claims 1 to 37, further comprising a housing, said housing supporting at least one of the fluid container, the adaptor or the needle.

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39. An ultrasonically enhanced device of claim 38, wherein the housing is adapted for manual manipulation.

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40. An ultrasonically enhanced device of claim 1, further comprising an infusion pump operatively connected to the fluid discharge means for supplying a fluid to the needle from a remote location.

- 35 -

41. An ultrasonically enhanced device of claim 40 further comprising a housing, said supporting at least one of the first conduit, the adaptor or the needle.

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42. An ultrasonically enhanced device of any one of claims 38 or 39 or 41, further comprising an ultrasound transducer, or multi-transducer array, supported in the housing and in contact with the first conduit in communication with the first passage, the ultrasound transducer or array for transmitting an ultrasound pulse or continuous ultrasound through the needle passage.

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43. An ultrasonically enhanced device of any one of claims 38 or 39 or 41, further including an adaptor for supporting an ultrasound transducer probe, or multi-transducer probe array, the ultrasound transducer probe or array for transmitting an ultrasound pulse or continuous ultrasound through the needle passage.

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44. An ultrasonically enhanced device of any one of claims 1 to 43, further comprising an ultrasound transducer, or multi-transducer array, incorporated into a manually actuated syringe, said ultrasound transducer or array positioned in contact with the first conduit in communication with the first passage, the ultrasound transducer or array for transmitting an ultrasound pulse, or continuous ultrasound, through the needle passage.

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25 45. An ultrasonically enhanced device of claims 42 or 43, wherein the ultrasound transducer is electrically connected to an ultrasound controller for control of one or more of frequency, duration, mode, or power of the ultrasound pulse, or for display.

- 36 -

46. An ultrasonically enhanced device of claim 45, wherein the ultrasound controller is incorporated with the controller.
47. A system for detecting an ultrasonically enhanced device, comprising:
- 5 a. an ultrasonically enhanced device of any one of claims 1 to 41;
 - b. an ultrasound transducer for transmitting and receiving pulses;
 - c. an ultrasound display; and
 - d. a system controller electrically connected to each of components (a) to (c), the system controller controlling, detecting or displaying the location of the
- 10 distal tip of the needle on the ultrasound display.
48. The system of claim 47 wherein the system controller is incorporated with the controller.
- 15 49. A method for detecting an ultrasonically enhanced device, comprising:
- a. dispensing a fluid from a distal tip of a needle of an ultrasonically enhanced device, the fluid having a selected flow rate for detection by an ultrasound device, the device having:
- i. a fluid container having a discharge end,
 - 20 ii. a fluid discharge means disposed in connection with the fluid container so as to define a fluid retaining reservoir, the discharge means for applying a selected pressure to a fluid in the fluid retaining reservoir for ejecting said fluid from the reservoir through the discharge end,
 - iii. a first conduit having an entrance end and an exit end and defining a
- 25 first passage therebetween, the entrance end disposed at the discharge end of the fluid container, the first passage in communication with the reservoir;
- iv. a needle having a connector end and a distal tip and defining a needle passage therebetween, the connector end disposed at the exit end of the first conduit, the needle passage in communication with the first passage;

- 37 -

- v. a fluid supply means operatively connected to the fluid discharge means for selectively applying the selected pressure to the fluid,
- vi. whereby the selected pressure ejects the fluid through the discharge end of the fluid container and travels a first flow path through the first passage and
5 through the needle passage; for ejection at the distal tip at the selected fluid flow rate;
- b. transmitting an ultrasonic pulse from an ultrasound transducer;
- c. receiving the ultrasound pulse by the ultrasound transducer; and
- d. detecting the fluid ejected from the distal tip.